REMARKS

Claims 1-57 are pending in this application. Of these pending claims, Claims 1-3, 5-7, 9-23, 35-36, 38-43 and 53-57 stand rejected; Claims 4, 8, 24-34, 37 and 44-52 stand withdrawn. By this amendment, claims 5-6, 14, 17-18, 21, 38-40, 53 and 55 have been cancelled, and claims 1-3, 7, 9, 12-13, 23, 35-36, 41, 43, 54 and 56 are herewith amended. Claims presently active are claims 1-3, 7, 9-13, 15-16, 19-20, 22-23, 35-36, 41-43, 54 and 56-67. Favorable reconsideration of the application in view of the following remarks is respectfully requested

Claim 1 has been amended to more clearly set forth the subject matter of the present invention. In particular, it has been clarified that the method produces a pair of stereo images customized for an individual user from an input stereoscopic image. It has also been clarified that the scene disparity map obtained in step b) corresponds to the input stereoscopic image. Further, it has been clarified that the aim disparity range determined in step c) is responsive to the stereoscopic image fusional range for the individual user and the obtained scene disparity map. Additionally, it has been clarified that the method produces a customized pair of stereo images for subsequent display by using the customized disparity map or the customized rendering conditions for the three-dimensional (3D) computer graphic model. Furthermore, a number of editorial changes were made to correct some wording inconsistencies and awkwardness. Each of these changes is clearly supported by the specification and does not involve the addition of any new matter.

Claims 2, 23, 36 and 41 have been amended to use "or" rather than "and" to connect lists of optional features.

Claim 3 has been amended to focus on only one of the optional features, rather than listing three different alternatives.

Claims 7, 9, 11-13 and 23 have been amended to be consistent with the language of amended claim 1.

Claim 35 has been amended to clarify that the received image and the processed image are stereoscopic images.

Claim 41 has been amended to clarify that the means for generating a customized disparity map is responsive to the stereoscopic image fusional range for the user. Furthermore, it has been clarified that the stereo images are re-rendered for subsequent display responsive to the customized disparity map.

Claim 43 has been amended in response to the Examiner's claim objection. Furthermore, it has been amended to clarify that the aim disparity range is determined based on the calculated optometric parameters for the individual user for the single accommodation plane of display and the comfort level related to the individual user's fusing capability.

Claim 54 has been amended to clarify that a customized stereoscopic image pair is determined by manipulating the relative disparity dependent upon a disparity map for the stereoscopic imagery and the image fusional range for the user.

Claim 56 has been amended to focus on only one of the optional features where the sensor provides sensory data about the user.

Claim 1 is considered to be representative of the independent claims in this case and will now be briefly reviewed. It has been found that different users have different abilities to fuse stereoscopic images. This ability can be characterized by a "stereoscopic image fusional range" (a range of depths that can be fused) and a corresponding "image disparity range" (a range of lateral offsets between corresponding features in a stereo image pair that produce the appearance of depth) which can be comfortably viewed by a user. Because different users have different stereoscopic image fusional ranges, this means that a stereoscopic image display with a particular disparity range that is pleasing for one user may not be pleasing for another user. Limiting the disparity range of an image to those that can be viewed comfortably by all users would produce a less satisfying experience for users who can comfortably view a larger disparity range. On the other hand, using a larger disparity range than can be comfortably viewed by the most sensitive users would result in an unacceptable experience for them. Thus, there is no one disparity range that will produce a satisfying experience for all users.

The present invention solves this problem by providing a customized stereoscopic image pair for use with a stereoscopic display. The method includes obtaining customization information including a stereoscopic image fusional range for an individual user. The disparity characteristics for an input stereoscopic image are obtained, and a new pair of customized stereo images is generated responsive to the customized stereoscopic image fusional range for the individual user. In this way, the stereoscopic display is customized to produce a comfortable viewing experience for the particular user.

Claim Objections

Claim 43 stands objected to for containing informalities relating to the step numeration. By way of this paper, Claim 43 has been amended by incorporating the features of step a) into the preamble and renumbering the remaining steps. Applicants believe that this amendment should address the Examiner's objection and respectfully request that the objection be withdrawn.

Claim Rejections – 35 U.S.C. § 101

Claims 1-23 and 53 are rejected under 35 USC 101 as not falling within one of the four statutory categories of invention. Claim 53 has been cancelled, and Claim 1 has been amended to make it clear that a processor is used to perform at least step e). The use of a processor to practice the steps of the present invention is clearly taught in the specification (for example, see the image processor 20 and the rendering processor 50 in FIG. 1). Claims 2-23 all depend from claim 1 and therefore include all of the features of the amended base claim. It is believed that independent claims 1-23 are now statutory in that they are tied to a processor, which represents statutory subject matter.

Claim Rejections – 35 U.S.C. § 103

Claims 1, 3-23, 35-36, 38-41, 43 and 53-37 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Woods et al. "Image Distortion in Stereoscopic Video System" in view of Dhond et al. "Stereo Matching in the Presence of Narrow Occluding Objects Using dynamic Disparity Search".

Woods et al. teach a method for characterizing distortions in a stereoscopic video system. Applicants respectfully disagree with the Examiner's characterization that "Woods discloses a method for customizing scene content according to a user or a cluster of users, for a given stereoscopic display..." Woods et al. do not teach any features that would enable producing a pair of stereo images customized for an individual user. Rather, they describe design rules that can be used to choose appropriate camera and display parameters to avoid system distortions in a stereoscopic display. Any design decisions that they make are made for the entire population of users and do not involve customizing the display for any individual user as is required by amended claim 1, and all of the other independent claims in this case.

The Examiner suggests that Woods et al. teach "obtaining customization information including a stereoscopic image fusional range for the user or cluster of users; (page 2; section 1.2, "V-viewing Distance", "e-Eye Separation')." Applicants respectfully disagree that the indicated subject matter relates to determining stereoscopic image fusional range for an individual user. The viewing distance and eye separation are not related to the image fusional range. Woods et al. do teach a method for obtaining an image fusional range in Section 3.1.1. However, rather than determining an image fusional range for an individual user and using it to produce a customized pair of stereo images, they determine a distribution of image fusional ranges across a population of users (see Figure 10) and use this to recommend a maximum depth range that can be used comfortably by as many people as possible. As they note, this can result in it not being possible to display the image without distortion. Thus, it can be seen that Woods et al. actually teach away from the present invention since they teach a configuration that accepts the distortions necessary to accommodate the majority of users even though significantly better performance could be obtained for many individual users. The method of amended claim 1 provides a way to overcome the limitations noted by Woods et al. by providing a customized pair of stereo images with a larger disparity range for those observers having a larger image fusional range, thus eliminating the distortions that are associated with optimizing the display characteristics for an entire population of users.

The Examiner suggests that Woods et al. teach "applying the customized disparity map or rendering conditions for rendering or re-rendering

the stereo images for subsequent display, wherein rendering or re-rendering the stereo images is responsive to the stereoscopic image fusional range for the user or cluster of users. (page 1, section 1 and page 10, section 3.1.1)." As has been discussed above, Applicants believe that a close reading of Woods et al. shows that they do not disclose a customized rendering of stereo images responsive to the aim disparity range for an individual user. Furthermore, there is no suggestion of using a customized disparity map or customized rendering conditions for a three-dimensional (3D) computer graphic model, responsive to the aim disparity range for an individual user. Applicants can find no evidence for these features in the indicated lines, nor anywhere else in the cited reference.

Dhond et al. disclose a method for creating an image disparity map for a stereo pair of images. The Examiner suggests that Dhond et al. teach "determining an aim disparity range for the user or cluster of users (page 721, section A, '[min_disp, max_disp]')." However, a close reading of Dhond et al. shows that the disparity range referred to in the indicated sections refers to the disparity range *of an image* not the disparity range *for a user*. The method of Dhond et al. is directed at taking a pair of stereo images and determining a corresponding image disparity map. This is done using a Dynamic Disparity Search-based (DDS) algorithm. The parameters "min_disp" and "max_disp" are disparity constraint parameters which are imposed during the Disparity Hierarchy Loop (DHL). Dhond et al. never describe determining a disparity range for a user, and, in fact, are not concerned with whether a user will be able to comfortably view the stereo image pair. They are simply interested in analyzing a stereo image pair to determine the image disparity map, which in turn can be used to determine depth information. Furthermore, Dhond et al. do not produce a customized pair of stereo images. In fact, they do not teach producing stereo image pairs at all, but rather teach analyzing an existing pair of stereo images.

None of the references, taken singly, or in combination, disclose, suggest or provide any motivation for the features of characterizing a stereoscopic image fusional range for an individual user and using this information to produce a customized pair of stereo images as required in amended claim 1. It is therefore believed that claim 1 represents new and non-obvious subject matter relative to the cited prior art, and should be in condition for allowance. Independent claims 35 and 54 all include the features of characterizing a stereoscopic image fusional

range for an individual user and using this information to produce a customized pair of stereo images and should be allowed for the same reasons as were discussed relative to claim 1. Claims 5-6, 14, 17-18, 21, 38-40, 53 and 55 have been cancelled. Claims 3, 7, 9-13, 15-16, 19-20, 22-23, 36, 41, 56 and 57 each depend from claims 1, 35 or 54, and should be allowed along with their corresponding base claim.

Relative to claim 9, the Examiner suggests that "Dhond further discloses wherein the step of generating a customized disparity map further including using the scene disparity map for specific scene content and aim disparity range according to the user in combination with a predetermined mapping function (page 721, section A)." Applicants respectfully disagree. The customized disparity map of the present invention is determined responsive to the aim disparity range for an individual user. As discussed above, Dhond et al. do not teach determining an aim disparity range for a user. Nor do they teach forming a disparity map customized for an individual user. The disparity map determined by Dhond et al. is determined for a particular image, and is independent of any individual user. Furthermore, Dhond et al. do not apply a predetermined mapping function to a first disparity map to generate a customized disparity map. Rather, they are only concerned with determining the first disparity map for the input stereo image pair, and are not concerned with modifying the disparity map once it is determined. For these reasons, Dhond et al. can not possibly teach the features of claim 9.

Relative to claim 10, the Examiner suggests that "Dhond further discloses wherein the predetermined mapping function being dependent on a region of interest (page 721, Section A, 'BG and FG')." Applicants respectfully disagree. As discussed above, Dhond et al. do not teach the application of a predetermined mapping function, and therefore can not possibly teach that the predetermined mapping function is dependent on a region of interest. The "BG" and "FG" regions described by Dhond et al. correspond to portions of the disparity range in back of and in front of a zero disparity plane. There is no suggestion that these correspond to "regions of interest," nor is there any suggestion of applying different mapping functions to modify the disparity map in these regions. While Dhond et al. do teach an iterative process where the estimate of the disparity map is refined during each successive iteration, any modifications

to the disparity map are made to produce an improved estimate of the correct input disparity map for the input stereo image pair, and are not made to produce a customized disparity map in response to an aim disparity range for an individual user. The same arguments apply to the Examiner's comments relative to claim 11.

Relative to claim 12, the Examiner suggests that "Woods further discloses wherein the rendering intent being dependent on skill of the user within a stereoscopic viewing environment (page 2; section 1.2)." Applicants respectfully disagree. Applicants can find no discussion of the "skill of the user" in the indicated section which comprises a list of terminology definitions. As discussed on page 10, line 31,-page 11, line 1 of the present specification, user skill can be characterized by categorizing a user as "new user" or "experienced user." Woods et al. do not include any discussion of the level of skill or experience of a user. Likewise, relative to claim 13, Applicants can find no reference to the "type of task" a user will perform in that same section . As described on page 13, lines 1-3 of the present specification, examples of task type would include "Provide a fun and comfortable experience," "Optimize detectability" or "Maximize depth near the pointer." Woods et al. do not include any discussion of task types or of determining an aim disparity map responsive to a type of task.

Relative to claim 19, the Examiner suggests that "Dhond further discloses wherein the region of interest being based upon a measurement of fixation position (Fig. 3; chapter IV-C)." Applicants respectfully disagree. Applicants can find no discussion of fixation position in the indicated section. A fixation position corresponds to an image position where a viewer is fixating his gaze (e.g., see page 15, lines 14-16). Applicants can find no discussion of a user looking at a particular image position. Likewise, relative to claim 20, Applicants can find no discussion of a map of probably fixations in the indicated section.

Relative to claim 36, the Examiner suggests that Woods discloses this feature relative to Figure 1 and page 2, section 1.1. It is not clear which one(s) of the "at least one" features the Examiner believes that Woods teaches; however, the Applicants do not find a reference to any of these features in the indicated section. The viewing geometry shown and described do not relate to any of the enumerated user specific characteristics (capability of the user to

converge the user's eyes, a capability of the user to diverge the user's eyes, a user's phoria, a user's capability of accommodation, a user's range of fusion). Nor is there any discussion of a rendering intent of the image. As defined on page 10, line 28-page 11, line 1 of the present specification the term rendering intent "includes task related options as shown in Fig. 3, such as 'optimize detectability' 210, 'provide a fun and comfortable experience' 212, or 'maximize depth near the pointer' 214. The rendering intent may also include skill related options, such as 'new user' 216 or 'experienced user' 218." Woods does not teach any rendering intent features such as these.

Relative to claim 43, the Examiner suggests that Woods discloses a stereoscopic display system that determines an aim disparity range using each of the claimed steps. Applicants respectfully disagree. Optometric data relates to data describing a human viewer's optical system, such as data that would be measured by an optometrist. "The optometric data may include but are not limited to the following parameters: interpupillary distance, dissociated phoria, fusional reserves" (see page 13, lines 24-28). The only one of these parameters that Woods et al. even mentions is "eye separation" (which would be analogous to the "interpupillary distance"). No where do Woods et al. discuss any optometric parameters that would be a function of accommodation plane. No where do Woods et al. teach a means for generalizing optometric parameters. No where do Woods et al. teach a means for calculating optometric parameters for a single accommodation plane of a display using the generalized optometric parameters. And most importantly, no where do Woods et al. teach a means for determining an aim disparity range for an individual user based on the calculated optometric parameters for the individual user for the single accommodation plane of display and a comfort level related to the individual user's fusing capability. As discussed earlier, Woods et al. do describe a method for measuring a disparity range corresponding to the fusing capability for a population of users in section 3.1. However, the fusing capability is measured directly, and is not determined using optometric parameters for a single accommodation plane.

None of the references, taken singly, or in combination, disclose, suggest or provide any motivation for the feature of determining an aim disparity range for an individual user based on the calculated optometric parameters for the individual user for the single accommodation plane of display and a comfort level

related to the individual user's fusing capability in claim 43. It is therefore believed that claim 43 represents new and non-obvious subject matter relative to the cited prior art, and should be in condition for allowance.

Claim 2 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Woods et al. "Image Distortion in Stereoscopic Video System" in view of Dhond et al. "Stereo Matching in the Presence of Narrow Occluding Objects Using dynamic Disparity Search", and further in view of Zhang (US 2003/0197779).

Woods et al. and Dhond et al. have been discussed above. Zhang et al. disclose a video-teleconferencing system with eye-gaze correction. They teach using a stereo image capture system to generate a virtual image of an individual participating in a video conference. Neither Zhang et al., nor any of the other cited references, taken singly, or in combination, disclose, suggest or provide any motivation for the features of characterizing a stereoscopic image fusional range for an individual user and using this information to produce a customized pair of stereo images as in amended claim 1, upon which claim 2 depends. It is therefore believed that claim 2 represents new and non-obvious subject matter relative to the cited prior art, and should be in condition for allowance.

Allowable Subject Matter

Applicants thank the Examiner for the indication that claim 42 represents allowable subject matter.

CONCLUSION

In view of the foregoing remarks and amendment, it is respectfully submitted that the claims in their present form are in condition for allowance and such action is respectfully requested.

Should the Examiner consider that additional amendments are necessary to place the application in condition for allowance, the favor is requested of a telephone call to the undersigned agent for the purpose of discussing such amendments.

Respectfully submitted,

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If the Examiner is unable to reach the Applicant(s) Attorney at the telephone number provided, the Examiner is requested to communicate with Eastman Kodak Company Patent Operations at (585) 477-4656.